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MISTING APPARATUS FOR APPLICATION OF COATING  
MATERIALS TO SKIN SURFACE

RELATED APPLICATIONS

Priority is claimed to the following applications:

Serial No. 60/123,932, filed March 12, 1999

(Electrostatic Misting Booth For Application Of Coating

Materials To Skin Surface); Serial No. 60/124,652,

filed March 16, 1999 (Electrostatic Misting Booth And

Misting Apparatus For Application Of Coating Materials

To Skin Surface); Serial No. 60/126,632, filed March

29, 1999 (Electrostatic Misting Booth With Vertical

Moving Nozzles For Application Of Coating Materials To

Skin Surface); and Serial No. 60/126,986, filed March

29, 1999 (Electrostatic Misting Booth And Misting

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Apparatus With Vertical Moving Nozzles For Application  
Of Coating Materials To Skin Surface)

**BACKGROUND OF THE INVENTION**

5           Field of the Invention

          The present invention relates to a system for  
delivering skin coating chemical compositions directly  
to the skin. More particularly, the invention relates  
to methods and apparatus for applying such coatings  
10       onto the skin using a principal of electrostatic  
misting.

Background of the Invention

          Conventional skin coating products, whether  
15       designed for cosmetic, treatment or medical purposes,  
are often liquid or viscous or semi-solid products.  
Most of them are produced in the form of lotions or  
creams. These products are traditionally applied by  
gentle massage or rubbing-in with the fingers. These  
20       methods of application necessitate the addition of  
relatively large amounts of adjunct material, i.e.  
other than the one or more active ingredients necessary  
to achieve the desired result. Most of these adjunct

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materials are added to create an aesthetically acceptable product and act as a carrier to deliver the active agent to all parts of the skin. These known delivery systems are wasteful of cosmetic raw materials and have limited efficiency in delivering a desired active ingredient to an intended site. Control over the applied dosage is difficult and limited and the application of the product itself is often time consuming and messy.

In addition, the presence of any significant amounts of stabilizing ingredients such as surfactants, polymers, preservatives, etc, may result in the user experiencing stickiness, greasiness, and possibly irritation. This may be particularly pronounced where skin is damaged or diseased, which may make the application of a product by massage or rubbing-in particularly undesirable.

In the case of coating compositions that are typically applied over the entire body i.e. sun tan lotions, self-tanning products, or moisturizers, application by massage or rubbing-in usually requires a second individual. This is necessary because the user of the product cannot reach and evenly coat all

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parts of the body unassisted. This is a significant disadvantage because a large percentage of the population would not have such an individual available to apply the product to those hard to reach places.

5           In addition to the above-described systems for delivering skin treatment agents, there are a small number of known examples where a skin cosmetic or therapeutic active is delivered using an aerosol spray. Two such examples are sprays for sunburn and sprains or  
10 other sports injuries. However, aerosol sprays, which are well known in the art for delivering personal products, also suffer from several disadvantages. First, the types of product and active agent that lend themselves to effective aerosol spraying are limited.  
15 Second, the use of aerosols still results in significant inefficiency and waste through non-target specific application (over-spray). This over-spray results in loss of active material to the atmosphere. It also creates unwanted mists which can damage  
20 surrounding objects if the active ingredient is reactive with whatever object the mist happens to fall on. The use of aerosols to deliver skin cosmetic or therapeutic active agents is also believed to be even

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less efficient than conventional massage or rubbing-in delivery regimes in the context of percentage and evenness of coverage of the skin surface. Although aerosols can be used to reach many of those hard to reach areas of the body that usually require a second individual for full body application, it is still difficult for a user to achieve a good even coating over the entire body without the assistance of another individual.

10           The skin is, in fact, a very complex material and has many important characteristics which must be considered in the design of an optimized system for delivering cosmetic or therapeutic actives thereto. For example, skin has a multi-faceted surface having  
15       both lipophilic and lipophobic character. This character allows the skin to "breathe" and release water vapor, yet function as an effective barrier against water, dirt and other unwanted materials. One particularly important physical feature of skin is its  
20       very rough surface terrain, which creates a problem in successfully applying a desired skin cosmetic or therapeutic active with complete and even coverage.

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In a very different technical field, the principle of electrostatic spraying of liquid and solid materials to increase the effectiveness of applying coating materials to objects is also known. In this technique a formulation to be sprayed is raised to a relatively high electric potential in a spray nozzle to cause the formulation to atomize as a spray of electrically charged droplets. Such electrically charged droplets seek the closest grounded object to discharge their electric charge. This can be arranged to be the desired spray target. Electrostatic spraying techniques have been proposed principally for only large-scale industrial and agricultural applications. Examples of these applications include delivering reactive materials like paints, adhesives, and other surface coatings, as well as large-scale delivery of pesticides and other agricultural or agrochemical formulations.

More recently, there have been a small number of proposals for utilizing the known principle of electrostatic spraying for delivering particular materials in specific applications other than those mentioned above. For example, EP-A-224352 (Ocular

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Treatment) suggests the use of an electrostatic sprayer for delivering a pharmaceutically active agent to the eye, to replace conventional ocular treatment using eye drops.

5           Other proposals for applying the principle of electrostatic delivery to the skin, for example, are disclosed in US Patent Numbers 5,268,166 (Cosmetic Application System), 5,494,674 (Skin Treatment System) and 5,322,684 (Cosmetic Delivery System). Each of  
10 these proposals suggests the same method of electrostatic spray application to coat the skin with different types of chemical compositions. In one proposal (US Patent Number 5,268,166) the coating compositions are color cosmetics, in another proposal  
15 (US Patent Number 5,494,674) the coating compositions are skin treatment agents, and in the final proposal (US Patent Number 5,322,684) the coating compositions are cosmetically active agents, such as, perfume.

20           In all three of the above proposals the basic application method outlined is basically the same:

(a) providing an apparatus which includes:



- 5 (i) a reservoir containing the coating composition to be delivered which is in an electrostatically sprayable form;
- (ii) at least one delivery means which is a nozzle in communication with the reservoir;
- 10 (iii) a high voltage generator generating voltage in the range of 2 to 20 kilovolts powered from an electricity source; and
- (iv) control means for selectively applying the high voltage from the generator to the at least one delivery means; and
- 15 (b) actuating the said control means to electrostatically spray the coating composition from the at least one delivery means directly onto the skin at an intended site.

20 The above proposals reference a number of possible "suitable electrostatic spraying hardware" including EP-A-441501 (Electrostatic Spraying Apparatus), EP-A-468736 (Electrostatic Spraying Device and Method), and EP-A-031649 (Containers and Holders Therefor for Use in Electrostatic Spraying). Each of



these referenced electrostatic spraying devices are handheld, self contained units where the reservoir, nozzle, generator, and control for applying high voltage from the generator are in the self-contained apparatus. It is apparent from the descriptions of the "suitable electrostatic spraying hardware" that the anticipated use of the methods described in US Patent Number 5,268,166, US Patent Number 5,494,674 and US Patent Number 5,322,684 was to apply the specified coating compositions to the skin on various small, localized areas of the body (e.g., the face) by electrostatically spraying them through a handheld self-contained device.

Although this method of application offers some advantages over aerosol spraying because it would eliminate some of the over-spray problem, it is still difficult to obtain effective uniform coating over the entire body or a substantial portion of the entire body. The uniformity of the coating is impacted by the distance of the nozzle from the skin, the rate of movement of the spray over various parts of the body, the number and intensity of spray bursts necessary to cover the coating area, etc. Because every user will

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apply the spray differently, each of the variables will vary from user to user and from spray session to spray session. Consequently, the lack of consistency in performance will affect the consumer's acceptance of this product concept.

In another technical field, spray painting, booths have been used to contain spray mists created by air or electrostatic spray painting of objects. These booths prevent the over-spray from landing on surrounding objects that were not part of the desired target. As the art of spray painting booth has evolved one undesirable result, particularly in the case of electrostatic powder painting, has been the coating of the walls of the spray booth which requires labor and down time to clean off. This coating of the booth walls is particularly costly in electrostatic powder coating because the powder adhering to the walls cannot be effectively recycled and the cost of materials is increased.

There have been a number of proposals to resolve this problem of the booth walls being coated. US Patent Number 5,833,751 (Powder Coating Booth Having Smooth Internal Surfaces) proposes, "a powder coating

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booth comprising a pair of identical polycarbonate shells disposed opposite each other to define a coating chamber having smooth, curvilinear surfaces to facilitate the recovery and recycle of excess coating powder."

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US Patent Number 5,277,713 (Cabin for Spray Coating Objects with Powder), for example, describes a cabin for spray coating objects with powder. In the *Summary of the Invention* it is specified "[w]ith the present invention, the advantages obtained are that the cabin can be produced in a very inexpensive manner, and nevertheless offers greater reliability against electrical arcing, and is electrostatically neutral, or has a repelling effect for many different kinds of powders, so that no or only a few powder particles can collect on the inner surfaces of the cabin." Moreover, US Patent Number 5,527,564 (Method and Apparatus for Repelling Overspray in Spray Paint Booths) describes a method and apparatus for repelling over-spray in spray paint booths. In the *Summary of the Invention* of the '564 patent, it is specified, "[a]mong its several aspects and features, the present invention provides an electrically charged panel which repels electrically

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charged dry or wet coating particles inside an electrostatic spray painting booth, or other booths having charged paint or powder particles therein." Later in the *Detailed Description of the Preferred*  
5 *Embodiment* of the '564 patent it is noted, "Better painting efficiency is achieved because the repelled paint particles will become available to adhere to the articles being painted".

Until recently, however, prior art in  
10 electrostatic spraying technology required that high voltage, 5 to 16 kilovolts, be generated and that the electrostatically sprayable compositions have resistivity in the range of 100,000 to 100,000,000,000 ohm centimeters. It was also recommended that the  
15 compositions either be non-aqueous or contain very small amounts of water, e.g., on the order of less than 5%. This was because an aqueous solution was difficult to spray effectively using electrostatic means due to it's low resistivity. The high voltage requirements  
20 made electrostatic spraying of coating materials on the human body too dangerous to be seriously considered. The non-aqueous solution requirement meant that the most effective and inexpensive carrier for the active

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coating ingredients could not be used effectively with this process.

However, recently there have been innovations in the field of electrostatic spray nozzles that have made this process more acceptable for the application of coating compositions in various fields such as industrial and agricultural applications. For example, US Patent Number 5,765,761 (Electrostatic-Induction Spray-Charging Nozzle System) and US Patent Number 5,704,554 (Electrostatic Spray Nozzles for Abrasive and Conductive Liquids in Harsh Environments) describe "air atomizing induction charging spray nozzles suitable for use with conductive liquids, solutions, suspensions or emulsions. The major advantage of the described method is the high level of spray charging that can be achieved at very low electrode voltages and power. The total power required is very low, typically less than 0.005 watts per nozzle. The introduction of this new "air-assisted induction charging system (AAIC)," which operates with low voltage and low current, makes it possible to utilize electrostatic spraying to create an electrostatic mist that could be used to apply a coating composition to the human body without the risk

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of any noticeable electrostatic shock.

#### SUMMARY OF THE INVENTION

5 To remedy the deficiencies of existing systems  
and methods, the present invention provides an  
apparatus for electrostatically coating a human with a  
coating composition. In one embodiment, the present  
invention includes an enclosure; a mount positioned on  
10 the enclosure; an electrostatic nozzle connected to the  
mount, the electrostatic nozzle for passing the coating  
composition; and a grounding connection positioned  
inside the enclosure, the grounding connection capable  
of electrically grounding the human; wherein the  
coating composition passed through the electrostatic  
15 nozzle is depositable upon the human.

Furthermore, in another embodiment, the enclosure  
includes a first wall wherein the mount is positioned  
on the first wall; and a second wall positioned  
substantially opposite the first wall, the second wall  
20 including a portion curved about an axis.

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**BRIEF DESCRIPTION OF THE DRAWINGS**

Various objects and advantages and more complete understanding of the present invention will become apparent and more readily appreciated by reference to the following Detailed Description and to the appended claims when taken in conjunction with the accompanying Drawings wherein:

FIGURE 1 is a cross sectional view of one embodiment of the booth.

FIGURE 2 is a cross sectional view of the operation of the booth of FIGURE 1.

FIGURE 3 is an expanded view of the electrostatic principles at work during operation.

FIGURE 4 is a drawing of the application system.

FIGURE 5 is a cross sectional view of a system used to provide vertical motion to the electrostatic misting nozzles.

FIGURE 6 is an illustration of the application system.

FIGURE 6a is an expanded cross sectional view of the AAIC nozzle.

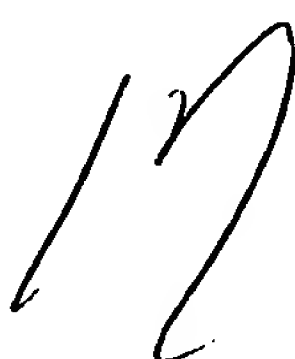
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FIGURE 7 is a view of an alternate embodiment of a booth constructed in accordance with the principles of the present invention.

5      **DETAILED DESCRIPTION**

Although the present invention is open to various modifications and alternative constructions, a preferred exemplary embodiment that is shown in the drawings is described herein in detail. It is to be  
10 understood, however, that there is no intention to limit the invention to the particular forms disclosed. One skilled in the art can recognize that there are numerous modifications, equivalences and alternative constructions that fall within the spirit and scope of  
15 the invention as expressed in the claims.

A preferred embodiment of the present invention is illustrated in FIGURE 1. The booth 1 consists of walls  
2 which can be constructed of a dielectric (non-conducting) material (preferably a thermoplastic which  
20 can be thermoformed in to the desired shape), a ceiling 3 that can be constructed of the same dielectric material, a door 5 that can be constructed of the same dielectric materials as the walls and ceiling, and a





floor 4 that can be made of a conducive material,  
preferably metal. Attached to one end of the booth 1,  
is a motion apparatus 6, which can be used to provide  
vertical (and in one embodiment horizontal) motion to  
5 at least one electrostatic nozzle 7 that is mounted to  
the motion apparatus 6. (In one embodiment, the  
electrostatic nozzle 7 is rotated/pivoted in an up-and-  
down direction rather than moved in a vertical  
direction.) Attached to the base of the wall 2  
10 opposite the motion apparatus 6 is an exhaust housing  
9 that can be opened on the end attached to the wall 2  
and connected to an exhaust conduit 10. The exhaust  
housing 9 can be made of a dielectric material and can  
contain an exhaust filter 8 on the open end attached to  
15 the wall 2 and an exhaust pen 9A. When the booth 1 is  
in operation, a user 11 could be standing inside the  
booth 1, possibly, on the floor 4 that can be  
constructed of conducive material that can be  
grounded. Thus, the user 11 would also be grounded.  
20 The user could also be grounded by any other means.

Referring now to FIGURE 2, there is illustrated  
the electrostatic misting booth 1 in operation. When  
the user 11 enters the booth 1 he closes the door 5 and


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stands at a predetermined spot, which can be at an  
elliptical end of the booth, as shown in FIGURE 4,  
facing the electrostatic misting nozzle(s) 7. He could  
activate the system by pressing the start button 13 or  
5 by any other means. This activates a misting cycle  
from the electrostatic misting apparatus 12 that can be  
configured to deliver a specific volume of the coating  
composition. One example of a coating composition that  
might be used is a sunless tanning solution made of  
10 water (70%), dihydroxyacetone (8.75%), bronzing dye  
(7%), Carbopol 940 solution (4.2%), Propylene Glycol  
(1%), Lexorez TC-8 (3%), Octyl Palmitate (2%), and the  
following components in concentrations of less than 1%;  
Methyl Paraben, Germall II, Aloe Versa 10X, L-Tyrosine,  
15 Stearic Acid, Stearyl Alcohol, Glyceryl Monosyearate  
SE, Isopropyl Myristate, and Triethanolamine.

As the coating composition passes through the  
nozzle(s) 7 the composition is atomized into tiny  
droplets 15 and the droplets are charged. Because  
20 particles of like charges repel each other, once they  
leave the nozzle(s) 7, the droplets 15 spread into a  
mist. As the misting process is occurring, the  
nozzle(s) 7 can be moved (vertically, horizontally, or

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rotated) by the motion apparatus 6 to more evenly  
distribute the mist. Once the charged droplets 15  
enter the larger space in the booth 1 they separate  
from each other rapidly and begin to fill the booth 1  
5 with an electrostatic mist. The user 11 would be  
standing downstream of the airflow 14, and the initial  
force of the airflow 14 and/or the electrostatic force  
between the grounded user 11 and the charged droplets  
15 can result in the creation of a uniform layer of the  
10 coating composition on the front side of the user 11.  
As the charged particles 15 move past the user 11 they  
lose the horizontal momentum generated by the airflow  
14 of the nozzle(s) 7, and begin to succumb to the  
forces of gravity and descend vertically. As these  
15 excess charged droplets descend they are attracted to  
neutral or positively charged objects. Because the  
walls 2 are the first neutral object these excess  
droplets 15 come into contact with they can quickly  
begin to attach to the walls 2. Due to the dielectric  
20 nature of the walls 2 the negative charges passed on by  
the charged droplets 15 soon create a negative  
electrostatic charge 16 on the walls 2. Once this  
occurs the electrostatic charge 16 on the walls 2



begins to repel the remaining charged droplets that are descending. At this time the only other grounded object in the booth 1 is the grounded user 11 in the center. In an alternative embodiment, the walls 2 can  
5 be charged or coated with a charged material prior to the excess droplets 15 coming into contact with them. In this way, the walls 2 then can repel the excess droplets even more efficiently.

Now referring to FIGURE 3, there is illustrated  
10 the electrostatic coating process resulting in the booth 1. Because electrostatic forces 16 are exerted perpendicular to the charged surface, the electrostatic charge on the walls 2 repels the charged droplets toward the center of the booth 1. Because the booth 1  
15 is filled with a mist of charged droplets 15 each charged droplet 15 that is repelled from the walls exerts an electrostatic force on the charged droplet 15 next to it, thus forcing that charged droplet 15 towards the center of the booth. This process is  
20 repeated until a charged droplet 15 is close enough to the grounded user 11 at the center of the booth 1 to be attracted to him/her. Once this occurs the electrostatic forces 16 pull the charged droplet onto



the skin of the grounded user and forms a thin coating. This process is continuous as the charged droplets descend downward. The result is an even layer of the coating composition over the user 11. Because the quantity of coating material on the front of the user 11 might be more than that on the backside due to the additional deposition caused by the airflow 7, the user could turn around and repeat the procedure to have an even coating over the whole body. Although, in one embodiment, the user need not turn to achieve an even coating.

Referring back to FIGURE 2, once the second coating process is complete an exhaust fan 9A starts and pulls the excess mist through a filter 8 into an exhaust conduit 10 to remove the remaining residual charged droplets 15 from the booth 1.

Referring now to FIGURE 4, there is illustrated a view of one embodiment of the misting system at rest. This drawing illustrates that in a preferred embodiment the booth 1 walls 2 would create an elliptical shape on one end that can approximate the horizontal shape of the human body and, therefore, could be an ideal

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configuration for maintaining the walls 2 equidistant from the grounded user 11.

Referring now to FIGURE 5, there is illustrated a view of one possible type of motion apparatus 6. In this version of the motion apparatus 6, motion is provided through a worm (screw) shaft 17, although motion can be provided in a number of ways including by a cylinder, a cable and pulley system and the like. In the embodiment including a worm shaft, when the misting cycle is activated by the user 11, the electric motor 18 attached to the worm shaft 17 begins to turn the shaft 17. As the shaft 17 turns the configuration of support bars 20, guide collars 21 and guide shafts 24 prevent the traveling nut 19 from turning thus forcing it to follow the threads up or down depending on which direction the electric motor 18 is turning the worm shaft 17. When the traveling nut 19 reaches the top most or bottom most position the direction of the electric motor 18 can be reversed by a sensor and the traveling nut 19 moves in the reverse direction. As the traveling nut 19 moves up or down the electrostatic misting nozzle(s) 7 move with it because they are attached to the support bars 20. As the misting, for



example, nozzle(s) 7 move they spray electrostatic mist through the misting slots 23 located in the separation wall 22 that separates the motion apparatus 6 from the electrostatic misting booth 1.

5           Other types of motion apparatus 6, for example, might use pulleys and cables, compressed air, and/or hydraulic fluids to provide motion for the nozzle(s) 7. Another embodiment could merely rotate/oscillate or pivot the misting nozzles to achieve the same results.

10           Referring now to FIGURE 6, there is illustrated an isometric view of the electrostatic misting apparatus 12 consisting of an air compressor 24 which is connected to conduit that delivers the compressed air to the nozzle 7 and the coating composition reservoir 15 25. The coating composition reservoir 25 is connected to conduit that delivers the coating composition to the nozzle 7. The air flow 28 to the coating composition reservoir 25 is controlled by the air flow regulator 27 and monitored through the air pressure gage 26. The 20 liquid flow 29 is generated by the air pressure in the reservoir 25 which forces the liquid out. (In an alternate embodiment, the liquid flow is generated by a liquid pump.) Moreover, FIGURE 6A illustrates the

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electrostatic misting zone 31 where the air and liquid come together and are negatively charged by the electrode 30.

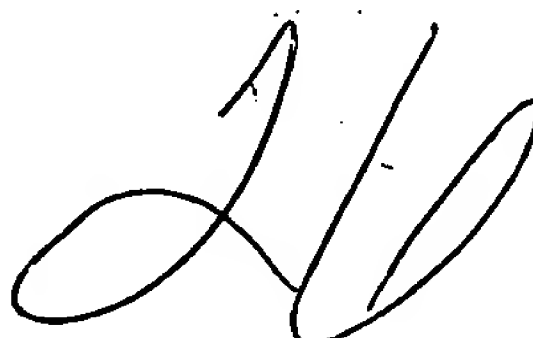
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In another embodiment of the present invention,  
5 the misting solution is disbursed through the use of  
a misting chamber rather than moving nozzles. For  
example, FIGURE 7 illustrates a booth 1 using a misting  
chamber 32. The booth 1 consists of walls 2, a ceiling  
3 and door (4), all of which can be made of dielectric  
10 material. The booth 1 also includes a floor 4,  
possibly, made of a conductive material such as metal.  
Attached to the upper section of one of the walls 2 or  
to the ceiling 3, high enough to be above the head of  
any potential user of the booth, is a misting chamber  
15 32 which consists of a cylinder made of a dielectric  
material open on the end attached to the wall 2 or  
ceiling 3 enclosed on the end away from the wall 2 or  
ceiling 3. Attached to the closed end of the misting  
chamber 32 is at least one electrostatic nozzle 7 which  
20 is part of the electrostatic misting apparatus 12 used  
to create the electrostatic mist. Attached to the base  
of wall 2 is an exhaust housing 9 which is opened on  
the end attached to the wall 2 and connect to an





exhaust conduit on the end away from the wall 2. The exhaust housing 9 is made of a dielectric material and contains an exhaust filter 8 on the open end attached to wall 2 and exhaust bin 9A. When the booth 1 is in operation, user 11 would be inside the booth 1 standing barefoot on the floor, which can be constructed of a conductive material that is grounded -- thereby grounding the user 11.

In another embodiment of the present invention, a device is included that produces a negative electrostatic charge on the walls 2 of the booth. By producing a negative electrostatic charge on the walls of the booth, the charged particles of the misting solution are repelled from the walls 2 with greater force, thereby increasing the efficiency of moving the charged droplets to the center of the booth. Additionally, a perforated inner wall layer (not illustrated) can be added to the misting booth and air can be forced outward through the perforations toward the center of the booth, thereby forcing the charged droplets away from the wall and toward the center of the booth. Furthermore, the booth shape can be altered to include circular, hexagonal, octagonal, or even



rectangular shapes, and one embodiment of the present invention includes misting nozzles at different sides of the booth, possibly, with the user positioned between them. By positioning the misting nozzles in this fashion, the user can be coated in his entirety without rotating. Alternatively, the misting nozzles can be spaced throughout the booth to provide even coating.

Those skilled in the art can readily recognize that numerous variations and substitutions may be made in the invention, its use and its configuration to achieve substantially the same results as achieved by the embodiments described herein. Accordingly, there is no intention to limit the invention to the disclosed exemplary forms. Many variations, modifications and alternative constructions will fall within the scope and spirit of the disclosed invention as expressed in the claims.

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